Global Terrorism Cases Around The World

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INTRODUCTION

In this project we decided to address a subject that happens all around the world every year, terrorism. The goals were to explore the incidents caused by it and to deeper analyze its occurrences.

In the making of this project we were able to determine the countries with most occurrences and what were the organizations more frequently targeted and the more frequent attack types, this is, in fact, very important information because in the perspective of a person reading the visualization it's possible to know what countries you should avoid due to their high volume of cases per year. This project serves, too, as a great prevention tool, this is given to the fact that it gives information about what attack types occurred the most and in which targets, this can be used to better prevent those attacks in those specific targets.

We did some research on the topic in which we found some websites that had visual information about terrorism but never had all visualizations linked in the way ours is, so we decided to do this project in order to make the visualization more compact and interactive with the most useful information possible in one single display, so the person consulting it can retain the most out of it.

We elaborated a series of questions in the beginning of this project:

1. Which regions around the world have the most incidents between 1970 and 2017?

2. Has there been an increase or decrease in the number of incidents over the years?

3. In which epoch of the year is terrorism more frequent?

4. Which are the most common targets of these attacks, i.e business, government or police…?

5. What kind of attack against a certain target type occurred the most?

6. Which incidents had fatalities? Can fatalities or not be related to the type of attack?

We were able to answer all the questions above by checking all the idioms of the visualization working at the same time.

RELATED WORK

When we were doing research about the domain we found the article "Terrorism"[1] wrote by Hannah Ritchie, Joe Hasell, Edouard Mathieu, Cameron Appel and Max Roser, published in July 2013 and last revised in October 2022. This article presents different visualizations, graphs and choropleth maps about cases and deaths related to terrorism. Other article related to our work is the "Global Terrorism Index 2022: Measuring the Impact of Terrorism"[2] wrote by the Institute for Economics & Peace. This article is a report that this institute publishes every year showing the impact of the terrorism around the world.

From all the articles we searched, only those two were worth mentioning because they were the only ones related with the project we decided to work on.

The problem with these articles is that the visualizations that exist in both of them are very limited and do not interact with each other, that is the point where our project enters. In this project we created an environment containing different visualizations that interact with each other allowing the user to gather information more concisely.

To create each visualization (choropleth map, line chart with dots, heatmap and the boxplot) we got inspiration in the site https://observablehq.com/@d3/gallery that contains several examples of visualizations.

THE DATA

The dataset we used is called Global Terrosrism Database funded through START, by the US Department of State and the US Department of Homeland Security Science and Technology Directorate's Office of University Programs. We got the dataset from kaggle through the link: https://www.kaggle.com/datasets/START-UMD/gtd?resource=download.

In the raw dataset there were a lot of columns that were unnecessary so we deleted all the columns that we did not need. To clear the data we used the excel filters in each column to be able to see the items with empty values. There were some cases where the month of the incident was 0, in these cases we decided to discard the entire item, because there was nothing that could say which was the real month of the incident and maintaining these items with a false value of the month could harm the visualization. For the

attack type and target type with missing values we considered these missing values as Unknown. For the number of kills the initial idea was to put a sentinel value (-1) for the missing values and when we did the visualization, we would consider this -1 as an unknown value for the number of deaths, but when we started to create the visualization we decided that the empty values would be equals to zero because otherwise the cases with "-1" deaths would be ignored.

To answer the 3rd question we created the derived measure called trimester, calculated based on the month that the incident occurred (months 1, 2 and 3 - 1st trimester; months 4, 5 and 6 - 2nd trimester; months 7, 8 and 9 – 3rd trimester; and to finish months 10, 11 and 12 – 4th trimester).

The challenge we faced with the data was when we created the choropleth map, because some of the names of the countries in the dataset were different from the names related to the map, for example in the map the United States had the name of USA but in the data set the name was United States of America, because of that we had to check each country name of the map and data set to ensure they matched.

VISUALIZATION

Overall Description

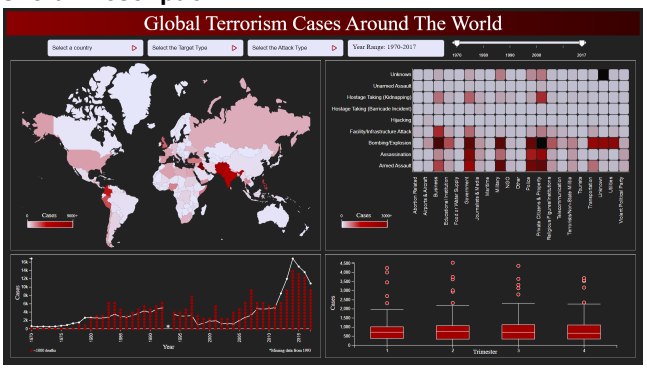

Figure 1 - Visualization layout

The Figure 1 shows the overall solution we came up with, it's composed of 4 different visualization techniques. All the visualizations have interactions with themselves, the filters and with the other visualizations.

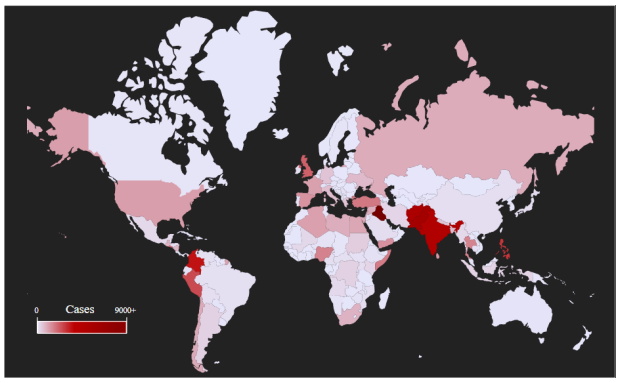

Figure 2 - Choropleth map

The first one is the more obvious one because if we are talking about representing terrorism cases around the world we immediately thought about a Choropleth map to represent them. (Figure 2)

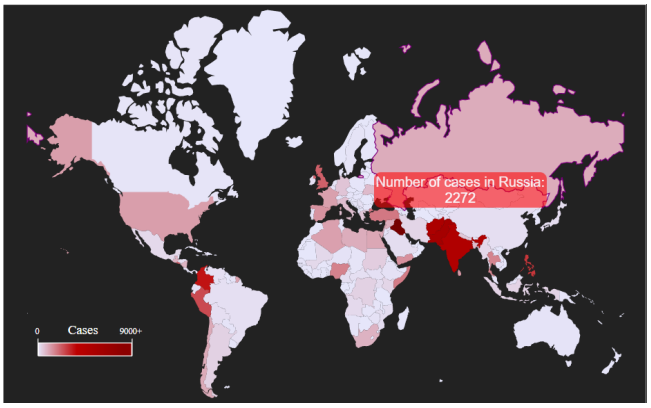

Figure 3 - Choropleth map with country highlighted

If we hover the mouse in a country like in Figure 3 the country becomes highlighted and shows us the number of terrorism cases in that country.

Figure 4 - Country filter with a country selected

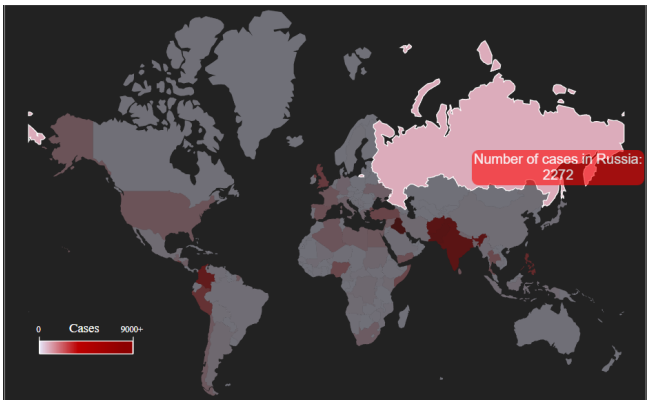

Figure 5 - Choropleth Map with country selected

If the country is clicked, it highlights the country and turns down the opacity of all the others to give emphasis to that specific country as seen in Figure 5. Also when this is done all other visualizations change accordingly. This is the same thing as choosing a country in the country filter (Figure 4).

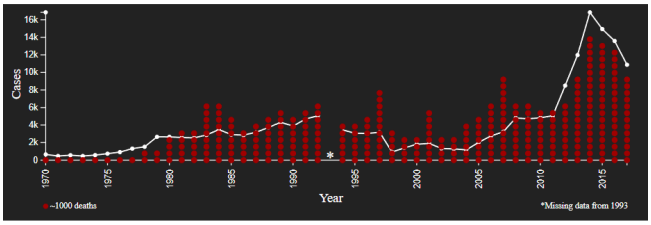

Figure 6 - Custom dotted line chart

The second vis is also our custom one. It is composed of a line chart that represents the number of cases per year (Note: information from 1993 was missing from our dataset so the line represents a discontinuity in this exact year). It also has red dots stacked on each year and each dot represents ~1000 deaths. (Figure 6)

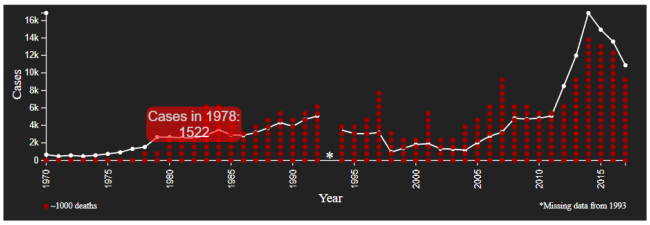

Figure 7 - Custom dotted line chart with line highlighted

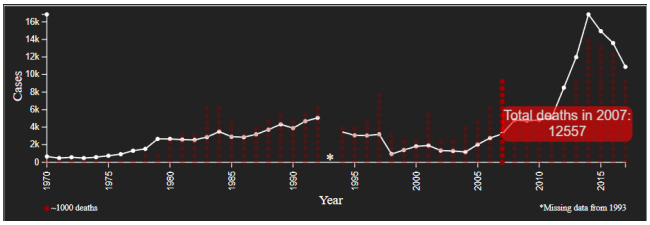

Figure 8 - Custom dotted line chart with dots highlighted

If we hover the mouse over the line we are able to get the accurate number of cases in that year and if we hover it over the red dots we are able to see the total number of deaths in that specific year, also the other dots' opacity is turned off to give emphasis to the ones selected as seen in Figure 7 and 8.

The third Vis is a HeatMap and it represents the attack types on the left axis and the target types on the bottom one. The darker the squares are, the more cases with the corresponding attack type and target type occurred.

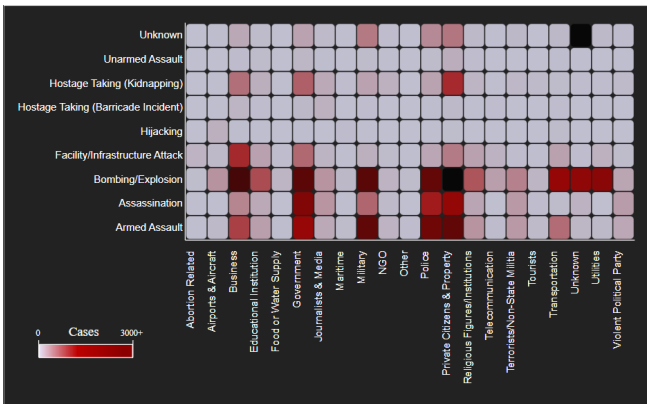

Figure 9- HeatMap

We are then able to hover over the HeatMap (Figure 9) and the corresponding column and line will be highlighted because it's easier that way to tell which line and column are selected. Also the square will tell us exactly the number of cases that are represented, in this example (Figure 10), by bombing/explosion in government facilities.

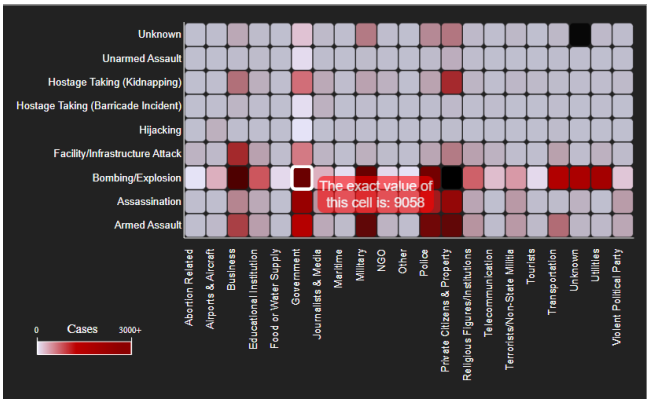

Figure 10- HeatMap with square highlighted

Figure 11- Target type and attack type filter

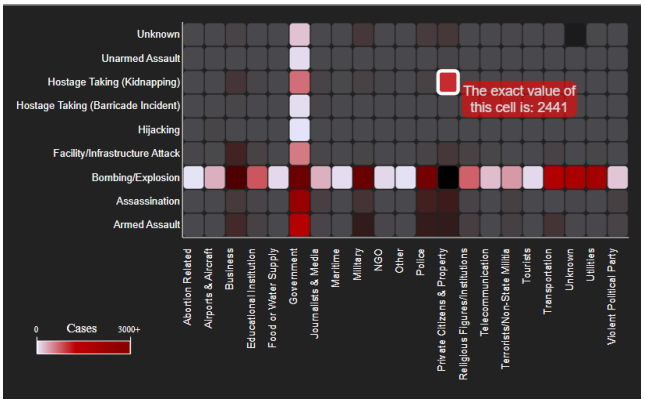

Figure 12- HeatMap with square selected

In the Figure 12 the Bombing/Explosion and Government square was clicked so as said previously the filters changed (Figure 11) and the line/columns remain selected but we're still able to roam freely in the heatMap.

The fourth and last visualization of our project is a boxplot that tells us the cases per trimester and this allows us to know even more info about each trimester, for example, what is the median and the outliers of that time period.

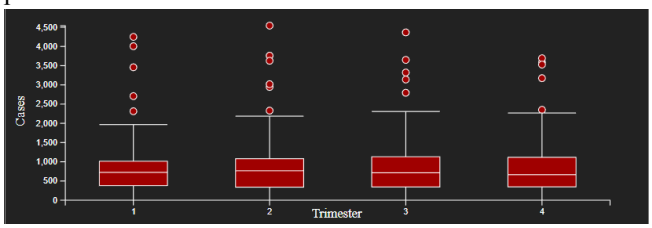

Figure 13 - Boxplot

While hovering on the boxplot rectangle we can get the general information of that plot and also hovering on the circles above (outliers) we get more detailed information of that specific occurrence as seen in Figure 14 and 15.

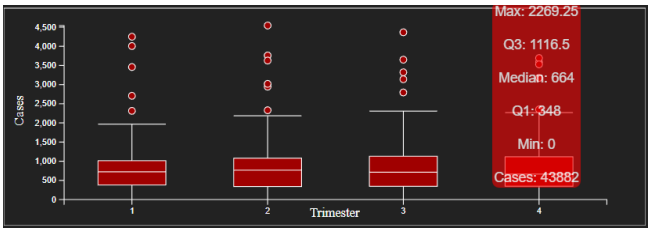

Figure 14- Boxplot with box tooltip

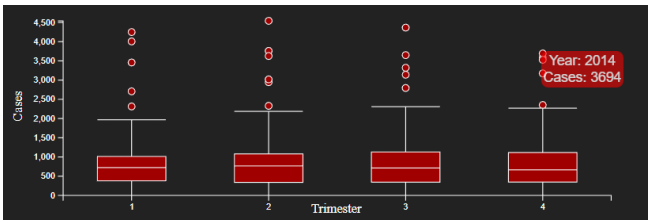

Figure 15- Boxplot with outliers tooltip

The project has four filters and all of them have a specific interaction with each visualization. The first filter is responsible for selecting information for a specific country.

The second one selects a target type and the third an attack type which only depicts information related to those selected. The last filter lets you define an interval of years or a year where you are able to see information only related to this year/interval.

The next images will display what happens with the visualizations when you change those filters (Note: only one filter will be selected at once for demonstration purposes but they can all be selected simultaneously).

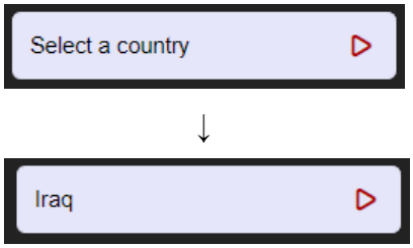

Figure 16 - Country filter with a country selected

Figure 17 - Choropleth map with country selected

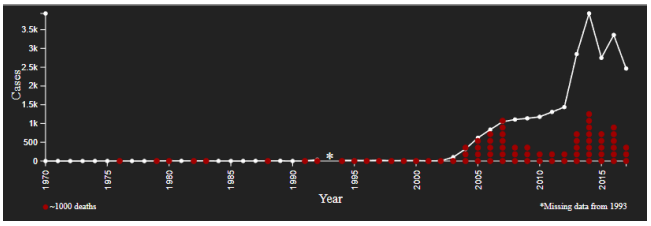

Figure 18 - Line chart with country selected

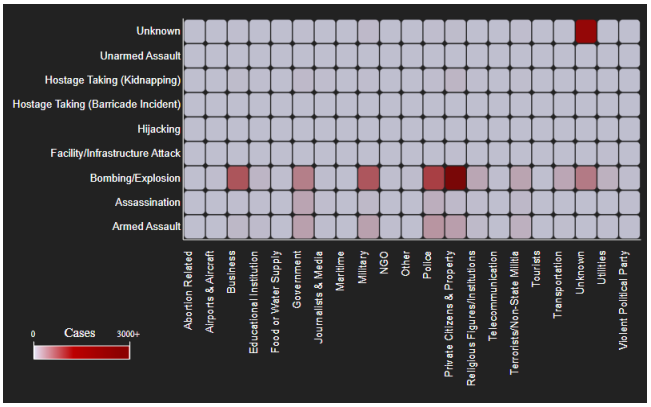

Figure 19 - Heatmap with country selected

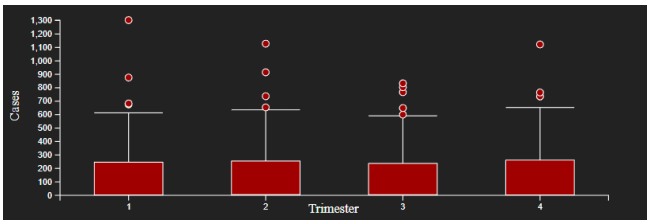

Figure 20 - Boxplot with country selected

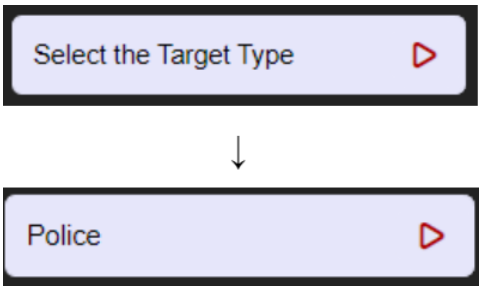

Figure 21 - Filter with target selected

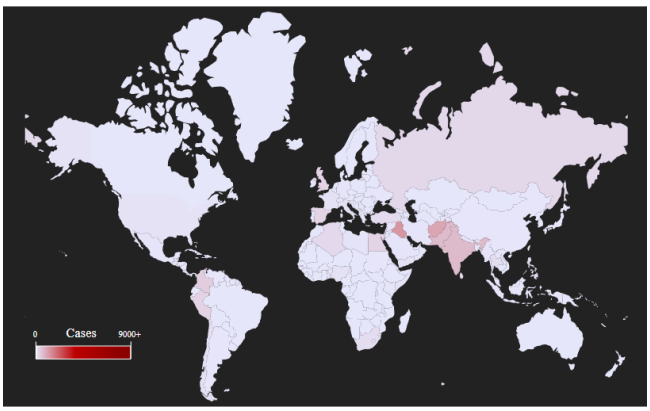

Figure 22 - Choropleth map with target selected

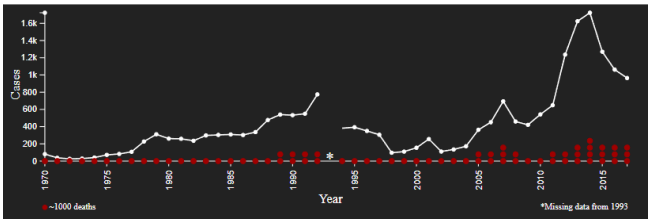

Figure 23 - Dotted line chart with target selected

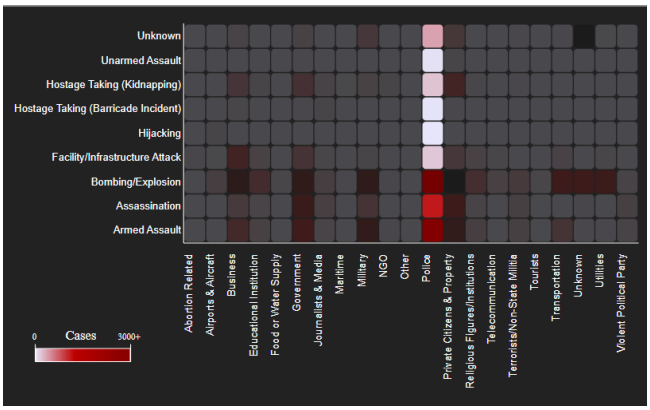

Figure 24 - HeatMap with target selected

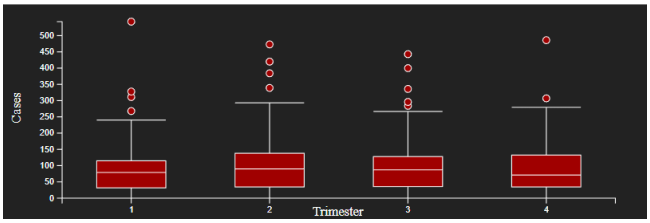

Figure 25 - Boxplot with target selected

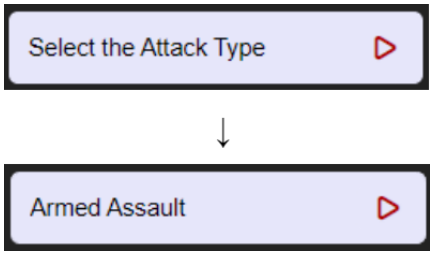

Figure 26 - Attack type filter with attack selected

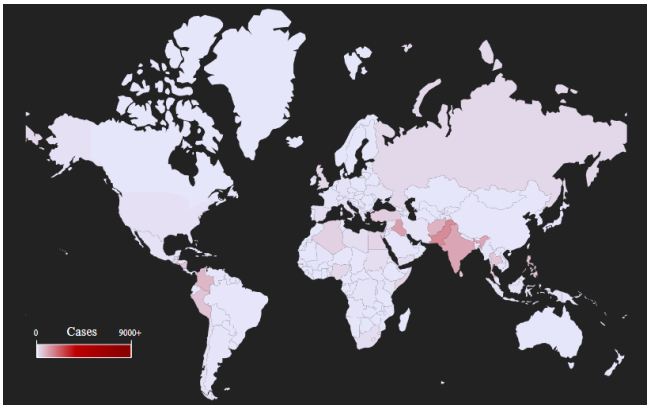

Figure 27 - Choropleth map with attack selected

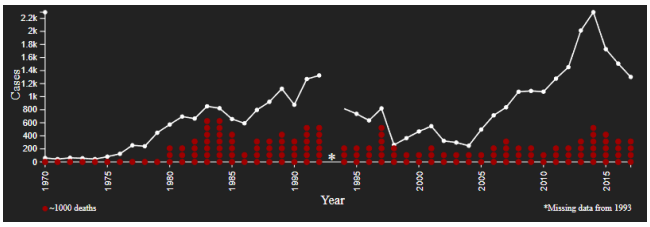

Figure 28 - Dotted line chart with attack selected

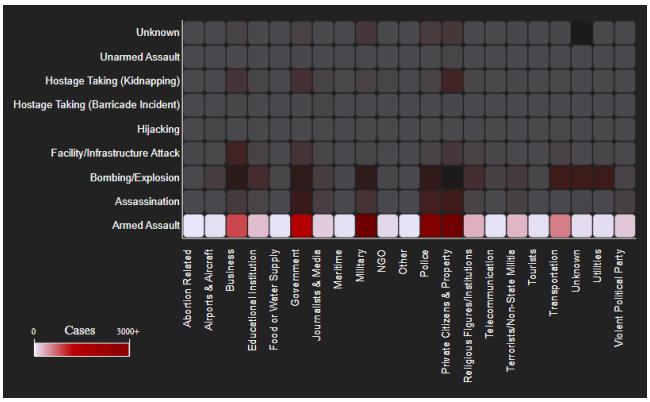

Figure 29 - HeatMap with attack selected

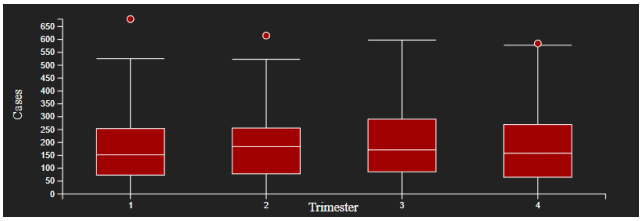

Figure 30 - Boxplot with attack selected

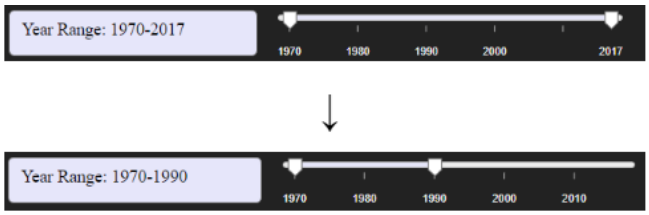

Figure 31- Year range filter with interval selected

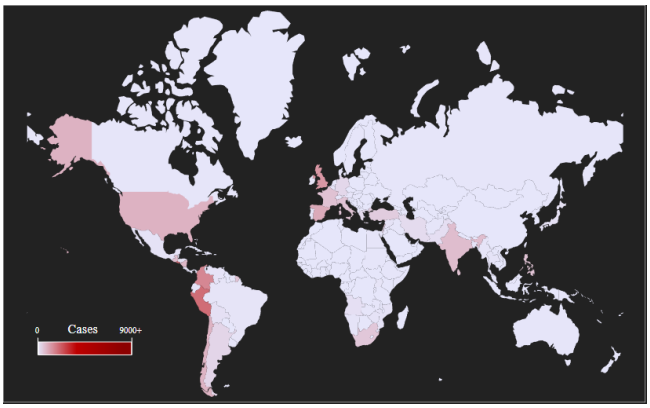

Figure 32 - Choropleth map with year range selected

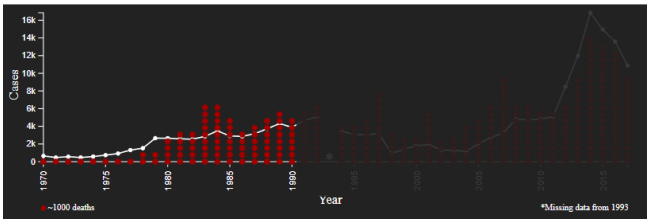

Figure 33 - Dotted line chart with year range selected

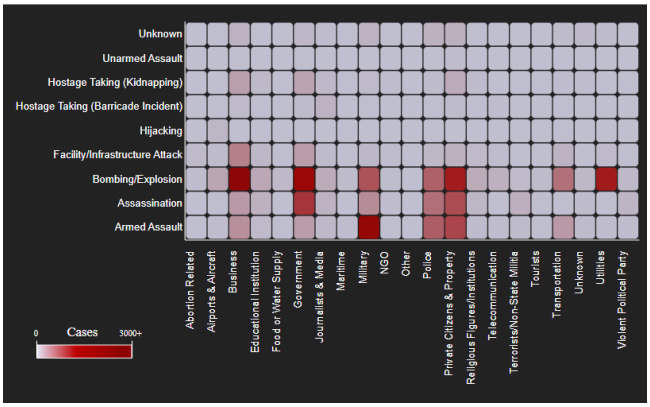

Figure 34 - HeatMap with year range selected

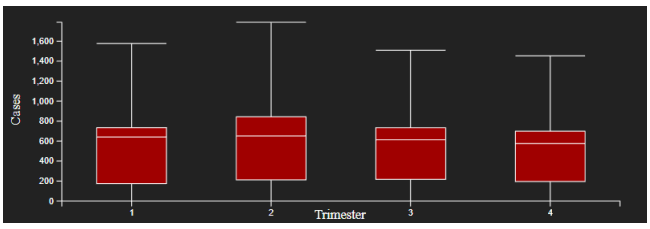

Figure 35 - Boxplot with year range selected

Rationale

Our techniques work because they are simple and intuitive. The data is represented in an interactive way and easy to understand. We chose to do a custom dotted line chart, a choropleth map, a Boxplot and a colored heatmap. Before we developed our 4 visualizations we considered doing a custom vis just like in Figure 36:

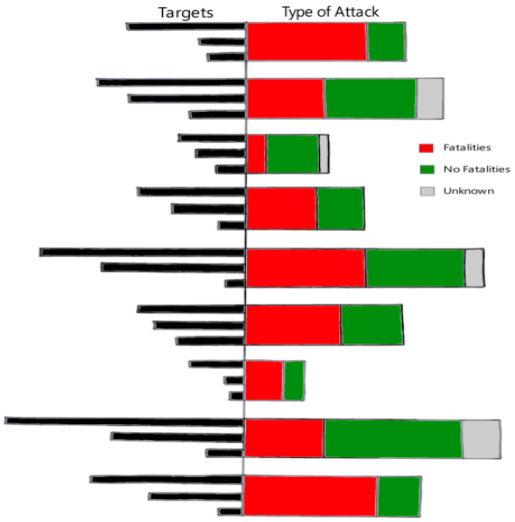

Figure 36 - Custom visualization

From version to version, we've made some improvements such as the filters. The slider range is one of the filters added after we decided that our previous year filter wouldn't work. Instead of a single year filter, we now can filter by an interval of years.

We also changed the colors of the overall visualization to better represent the meaning of the Data, for example background is darker then in the beginning of the project because we came up with the conclusion that given the fact that terrorism is a topic related to death and grief the darker color would represent it better, also the red colors for representing cases and death because red is associated with blood or danger.

Custom Visualization

For our typical idiom we chose to do a line chart. To customize it we added columns of red dots for every year under the line. The red dots represent the number of deaths and the white represents the number of cases. In addition to that, the line also helps to see the evolution of cases throughout the years. We chose to do this, because we concluded that it was concise to mix the number of deaths with number of cases since we are talking about terrorism. It helps answering the questions, because by looking at the chart you can see if there is any relation between the deaths and the number of cases and how it evolved with time.

Demonstrate the Potential

To demonstrate the potential of this visualization we will answer a couple of questions that were made earlier.

The first one is: "Has there been an increase or decrease in the number of incidents over the years?"

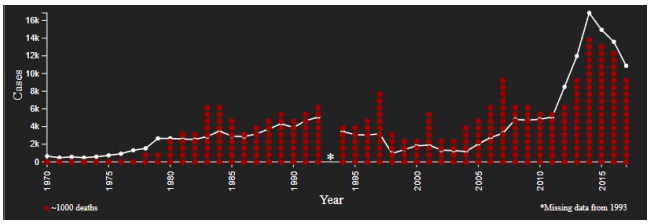

Figure 37 - Dotted line chart

As we can see in Figure 37 it's very clear that over the years there was an increase on the terrorism cases.

The second one is: "What kind of attack against a certain target type occurred the most?"

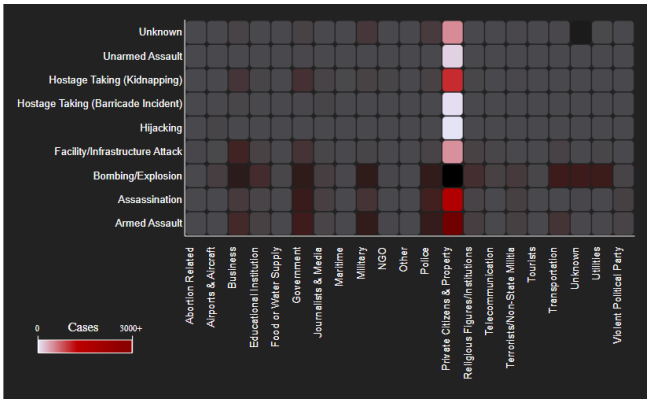

Figure 38 - HeatMap with target selected

To answer this question we can select a target type and in the case above (Figure 38) it's already possible to see that the bombing/explosion composes most of the cases of this target. In the demonstration above we could right away tell which was the most significant attack type but if it wasn't perceivable we could just hover on the squares and this would tell us what we wanted to know by showing the number of cases.

One interesting insight was when we were looking at Portugal and noticed that it contradicted the rest of the world because most of the cases were before 2000 while the rest of the world has seen an increase over the years Portugal has seen a decrease.

IMPLEMENTATION DETAILS

Initially none of the members of the project had any previous experience in D3, so the learning curve was a bit challenging but later on it eased out.

The first filter we implemented was a select button that had all the countries as options, so the approach that we

decided to take was to add a listener to this button and whenever it changed all the views would update accordingly, we ended up doing this for all the buttons with selection on them. When we selected the filter from the view itself we would then change the button to always present the current information.

Another approach was made regarding the year range filter, this filter has a slider and the slider, too, has a listener associated with it so whenever someone stops dragging the slider, all the views take the range in which it ended dragging and update themselves.

A big challenge was to handle the red dots on the line chart since each dot represents a certain amount of deaths that had to be previously calculated in order to represent and stack the dots, and since this is not a built in type of graph, every time the chart was updated the dots had to be redone manually.

Also a challenge faced when we were learning D3 was that the D3 example page had almost every graph we searched for outdated (using V3 or V4 and we are currently at V7) which made us adapt a lot of things that didn't work for ourselves.

CONCLUSION AND FUTURE WORKS

In the end of the development of this visualization we were able to answer all the questions.

We learned a lot about D3 itself but not only that. We learned about the importance of displaying and molding a raw dataset in our own way and the impact that the decisions made along the way could impact the final interpretation of the data, for example the colors used, the choice of the idiom, the interaction between the different idioms.. etc. All the details, no matter how small they are, can impact the final visualization. This made us, for sure, more critical of all visualizations that we see in the future and also more capable of developing some future work related to info vis.

If we started all over again, we probably would change a lot of things about the code, because at the beginning we didn't know a lot about this programming language so we sort of tricked some parts of the code in order to make it work. It isn't wrong, just a little confusing. If we had another month and more money to spend we would invest in real time data analysis in order to have better information to display and probably would put our visualization on an online domain so that everyone could try it out and get more knowledge about this subject as we did from making the visualization, also we think that this would be a great addition since we researched a lot and didn't find any visualizations that depicted this subject as ours does.

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